Study of cold atomic clocks in SIOM

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Abstract

In this report we will give a description of the research activity of atomic clocks in SIOM. We built an Rb atomic fountain and a model of Rb space clock. It is known that a precision clock is extremely useful in scientific research such as in test of fundamental prediction of General Relativity. For this purpose we are going to develop a precision Rb space clock. As the first step, we build an Rb fountain clock to get experiences in research. In this report firstly we will present the experimental results of the Rb fountain clock, such as magnetic shield, precision measurement of the magnetic field, determination of population distribution of atoms in the ground state and others. At present the narrowest Ramsey line width of 0-0 transition is achieved 0.9 Hz, S/N is about 100. Now we try to use 3 dimension optical lattices to improve the performance of the cold atom source. Secondly we will report the progress of research of space clock. The space clock is essentially based on the Rb atomic fountain, in which a different cold atom source is used. In the atom source, atoms are cooled down by red diffused light in an integral sphere. We try to apply Sisyphus cooling in the sphere to reduce the temperature of the atom gas, and to trap more cold atoms. Other feature of the constructer of this clock is application of a traveling micro-wave cavity. The idea of using a traveling wave cavity is proposed by Paris Observatory [1]. We designed and fabricated two traveling wave cavities; one is made from copper and other is from aluminum. We have measured and studied the characteristics of the field distribution in the cavity. At end of the report we shall discus a proposal of precision measurement of red-shift to test general relativities.